

State of Oregon
Department of Environmental Quality

Memorandum

To: Portland Harbor TCT **Date:** 14 August 2007

cc: Chris Kaufman
NWR Cleanup Section

From: Mike Poulsen
NWR Cleanup Section

Subject: Determining a Regional Anthropogenic Background Concentration of PCBs in Sediment Upstream of the Zidell Site

Zidell is in the process of refining the proposed remedial action at their site. A sediment cap is proposed to address PCBs in sediment. Benthic toxicity, which likely results from other chemicals such as metals, will also be addressed. In the record of decision (ROD), DEQ expanded the extent of the sediment cap originally proposed by Zidell. The current evaluation is an attempt to specify the actual extent of the cap between the boundaries proposed by Zidell and those specified by DEQ. For PCBs, the boundary will be established based on regional anthropogenic background levels. The current ROD limits the maximum extent of the cap to the area delineated by DEQ. If the sediment sampling results show areas near the limit of the proposed cap with high concentrations of PCBs, the decision regarding the maximum extent of the cap may need to be revisited.

For convenience, I will use the term "background" in this memo, although we usually reserve this term to refer only to naturally occurring levels. In this case, I use "background" to refer to anthropogenic regional levels upstream of the Zidell site.

In their *Supplemental Remedial Investigation: Sampling and Analysis Plan for Additional Sediment Assessment, Zidell Waterfront Property* (24 May 2007), Zidell evaluated existing PCB data from sediment samples collected upstream of the site to the Willamette Falls at Oregon City (approximately river miles 15 to 25). For total PCBs, they considered the sum of the top three detected Aroclors (1248, 1254, and 1260). The data are shown in Table 1 of the attached spreadsheet. They propose using the 90th percentile of the data as the background concentration, following a discussion with DEQ at meeting on 6 April 2007.

I had the following issues relating to the calculation of a background PCB value.

- Use of data from the vicinity of Ross Island (possibly influenced by site activities).
- Use of Aroclors in the total PCB sum that are not site-related chemicals of concern.
- Use of data with detection limits of 20 ug/kg and higher.
- Handling of non-detect values.
- Matching the appropriate upper percentile of the data with the distribution.
- Handling of statistical outliers.

I was originally concerned about using data from the Ross Island site (river miles 15-16) in the background dataset. However, the DEQ project manager considers the sediment sample locations sufficiently far from the site to not be influenced by site activities. Plus, PCBs are not chemicals of concern at the Ross Island site. Also, as it turns out, including the Ross Island data

does not have an important influence on the background calculations, especially after outlier values are removed.

A concern raised by Keith Johnson is that, in the total PCB calculation, they included Aroclor 1248, which is not an apparent chemical of concern at the Zidell site. Including additional Aroclors could raise the background total PCB concentration. I evaluated the results without Aroclor 1248 in the total PCB calculation, and determined that including Aroclor 1248 did not substantially alter the results. For the initial background calculations, we will sum only Aroclors 1254 and 1260, as shown in Table 1. However, we may revise this approach depending on the results of the next sampling round to see if there are detections of other Aroclors. We will need to consider this issue further in evaluating overall Portland Harbor data because of the downstream presence of many different Aroclors.

My next concern is the use of data with higher detection limits. The detection limits for about half of the samples are 2 to 4 ug/kg. The detection limits for the other half of the samples are 20 to 40 ug/kg. PCBs were only detected above the lower detection limits; PCBs were not detected when the detection limit was 20 to 40 ug/kg. I think including data with the higher detection limits biases the results high. I recommend that we omit the data with detection limits of 20 ug/kg or above. While this may bias the results low, I consider this a small concern. I also realize that it may not always be possible to obtain a detection limit of 20 ug/kg.

The distribution of PCBs was not discussed in the report. The full dataset does not appear to be lognormally or normally distributed. Our initial recommendation to use an upper percentile of the data comes from Washington Department of Ecology's *Statistical Guidance for Ecology Site Managers* (92-54), August 1992. The recommendation to use the 90th percentile is contingent on the data being lognormally distributed. Ecology's guidance for data that are normally distributed is to use the 80th percentile. If the data are not lognormal or normal, the recommendation is to use the non-parametric 80th percentile.

The regional background concentration of PCB in sediment proposed by Zidell is 18.5 ug/kg, based on the 90th percentile of all the data, including data with the higher detection limits. To check the appropriateness of this value, I used different approaches to evaluate the data. First, I evaluated the data including and omitting data with detection limits of 20 ug/kg or greater. I then used EPA's ProUCL version 4.0 software package to evaluate outliers in background data, and used multiple methods of including non-detect values.

My original thinking was to use the approach in Ecology's guidance to compare an upper confidence limit (UCL) on the arithmetic mean of site data with the upper percentile of the background data. Wyoming DEQ has similar guidance. EPA specifically addresses this type of comparison in their *ProUCL Version 4.0 Technical Guide* (EPA/600/R-07/041, April 2007). EPA states (on page 19) that "... the comparison of a 95% UCL of one population (e.g., a site) with a 90% or 95% upper percentile of another population (e.g., background) cannot be considered fair and reasonable ...". Given EPA's specific caution against this type of comparison, I have revised my recommendation to instead use a point-by-point comparison of site data with the upper percentile of background data. This may be appropriate for determining the extent of a remedial cap.

EPA prefers the use of the 95th percentile of background data. My initial preference was to use the 90th percentile of background data to follow Ecology's guidance and be more conservative. However, given that we will be making multiple comparisons with site samples, I agree with the use of the 95th percentile. We need to be aware of the potential for a high false positive rate. If 32 samples are collected, and if the sediment contains PCBs at the regional background level, there is an 80 percent chance that we will have one or more samples exceed the 95th percentile for background. If background is established at the 90th percentile, the analysis of 32 samples (at background) will result in a 97 percent chance of exceeding the upper percentile. To address this concern if the magnitude of exceedances is not substantial, I suggest that we also make a comparison of the distribution of site data with the distribution of background data. A comparison of distributions is the method preferred by EPA. If a difference is not indicated, the apparent exceedances may be false positives.

Another issue is how non-detect values should be considered. The decision rule as stated in the sampling report was to use the highest reporting limit (for the three Aroclors detected in at least one sample) as the total PCB value. Based on information provided by the Lower Willamette Group, the values presented in the sampling plan and Table 1 are one-half the detection limit for the Aroclors. This may be an appropriate approach, although EPA discourages the use of this simple method. Ecology's approach is to typically use one half the detection limit in calculations. This approach has also been used in Oregon, at least for screening calculations. Given the recent availability of EPA's ProUCL version 4.0 program, I decided to also use the more sophisticated methods of calculating statistical information. The primary purpose of the update to ProUCL was to add methods for considering non-detect data.

Finally, EPA advocates the evaluation of outliers in determining background concentrations. I used the options in ProUCL to evaluate outliers in the upstream PCB dataset. Using Dixon's outlier test, the first outlier identified was 37 ug/kg. After removing this datapoint, another outlier at 7 ug/kg was identified. (This concentration for this sample was reported as 12 ug/kg because it included a contribution of 5 ug/kg for Aroclor 1248, an Aroclor not detected at the Zidell site.)

Table 2 shows the results of the various statistical evaluations of upstream PCB sediment data. Using all values, including those with high detection limits, conducting the evaluation using ½ the detection limit for non-detect values, and taking the 90th percentile, we confirm the value proposed by Zidell of 18.5 ug/kg (rounded to 19 ug/kg). Omitting high detection limits lowered the upper percentiles using the basic, non-parametric method of calculating upper percentiles. Following EPA's recommendation for background, two statistical outliers were removed from the dataset. The resulting statistical evaluation is shown in Table 2. The recommended approach to handle non-detect values is the Kaplan-Meier method. Using this approach, the calculated 95th percentile is approximately 4 ug/kg. As noted above, use of an upper percentile may result in an unacceptable level of false positive values. In this case, EPA's recommended approach of comparing distributions should be used.

The determination of regional PCBs in sediment for the Zidell site may influence the determination of regional background levels for the Portland Harbor Superfund site. There may be legitimate reasons for differences, depending on how the background data are to be used.

However, because of possible implications for the Portland Harbor site, we are seeking TCT comments on the proposed decision for the Zidell site. We expect sediment sampling to occur in September, so we don't expect to receive preliminary sediment sampling results until October. Once we have reviewed the data and have received TCT comments on the approach for evaluating the data, we will continue discussions with Zidell on the evaluation of the background data.

Table 1
PCB Sediment Concentrations Upstream of Zidell Site

		Surface Sediment Concentration (ug/kg)		
Location (River Mile)	Sample Name	Aroclor 1254	Aroclor 1260	Total PCBs
Near Ross Island				
15.4	U1C-1	<2	4	4
15.4	U1C-2	<2	<2	<2
15.4	U1C-3	<2	<2	<2
16	U2C-1	2	2	4
16	U2C-2	26	11	37
16	U2C-3	<2	<2	<2
15.4	HC-REF-01	<3.4	<3.4	<3.4
15.3	HC-SS24	<20	<20	<20
15.5	HC-SS29	<20	<20	<20
15.3	HC-SS30	<20	<20	<20
15.6	HC-SS31	<20	<20	<20
15.9	HC-SS33	<20	<20	<20
15.6	HC01	<28	<28	<28
15.4	HC02	<29	<29	<29
Mid-section				
17	U3C-1	<2	<2	<2
17	U3C-2	1	2	3
17	U3C-3	<2	1	1
18	U4Q-1	2	<2	2
18	U4Q-2	<2	<2	<2
18	U4Q-3	<2	<2	<2
16	HC-SS103	<20	<20	<20
16	HC-SS32	<20	<20	<20
16	HC03	<35	<35	<35
17	HC04	<39	<39	<39
17	HC05	<30	<30	<30
18	HC07	<26	<26	<26
18	HC08	<37	<37	<37
Upper section				
25	U5Q-1	<2	<2	<2
25	U5Q-2	<2	<2	<2
25	U5Q-3	<2	<2	<2
23	U6TOC-1	<2	<2	<2
23	U6TOC-2	<2	3	3
23	U6TOC-3	3	4	7
23	HC-REF-02	4.7	<3.6	4.7
23	HC09	<34	<34	<34
23	HC10	<40	<40	<40

Notes: Detected concentrations are shown in **bold typeface**.
Total PCBs is sum of Aroclor 1254 and Aroclor 1260 concentrations.

Table 2
Statistical Evaluation of PCB Sediment Concentrations Upstream of Zidell Site

	Total PCB ^a Sediment Concentration in ug/kg			
			Percentile ^f	
Approach	Arithmetic Mean	Standard Deviation	90 th	95 th
All detection limits				
ND ^b at detection limit	15	14	36	38
ND at ½ detection limit	8.3	8.1	19*	20
Lognormal (ROS ^e)	2.9	6.0	5.4	7.7
Kaplan-Meier	3.2	6.1	11	13
Omitting high detection limits ^d				
ND at detection limit	4.8	7.7	4.9	8.5
ND at ½ detection limit	3.9	8.0	4.9	8.5
Lognormal (ROS)	3.8	8.0	7.9	13
Kaplan-Meier	3.9	7.8	14	17
Omitting high detection limits and outliers 37 ug/kg and 7 ug/kg				
ND at detection limit	3.1	1.2	4.1	4.9
ND at ½ detection limit	1.9	1.4	4.1	4.9
Normal (ND = ½ DL ^c)	1.9	1.4	3.6	4.1
Gamma (ROS)	3.3	0.71	4.6	5.0
Kaplan-Meier	1.9	1.3	3.6	4.1**

Notes

- a) Total PCB = sum of Aroclors 1254 and 1260
- b) ND = non-detect value
- c) DL = detection limit
- d) Detection limits of 20 ug/kg or higher were considered high.
- e) ROS = regression on order statistics
- f) Evaluations performed using EPA's ProUCL v. 4.0.
- * Screening value recommended by Zidell.
- ** Screening value recommended by DEQ. This will likely need to be used in conjunction with a comparison of site and upstream distributions.